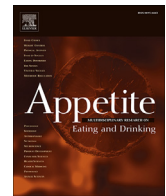


Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

Research report

Is there an association between food patterns and life satisfaction among Norway's inhabitants ages 65 years and older?

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ARTICLE INFO

Article history:

Received 2 May 2016

Received in revised form

8 December 2016

Accepted 13 December 2016

Available online 14 December 2016

Keywords:

Food patterns

Life satisfaction

Elderly adults

Anxiety

Depression

ABSTRACT

The lack of information regarding older adults' health and lifestyles makes it difficult to design suitable interventions for people at risk of developing unhealth lifestyles. Therefore, there is a need to increase knowledge about older adults' food patterns and quality of life.

Our aim was to determine associations among food patterns, anxiety, depression, and life satisfaction in Norwegian inhabitants ages 65+. The Nord-Trøndelag Health Study (The HUNT Study) is a large, population-based cohort study that includes data for 125 000 Norwegian participants. The cohort used for this study is wave three of the study, consisting of 11 619 participants age 65 and over. Cluster analysis was used to categorize the participants based on similarities in food consumption; two clusters were identified based on similarities regarding food consumption among participants. Significant differences between the clusters were found, as participants in the healthy food-patterns cluster had higher life satisfaction and lower anxiety and depression than those in the unhealthy food-patterns cluster.

The associations among food patterns, anxiety, depression, and life satisfaction among older adults show the need for increased focus on interactions among food patterns, food consumption, and life satisfaction among the elderly in order to explore how society can influence these patterns.

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1. Introduction

The number of adults age 65 and older years has more than doubled from approximately 420 million to 973 million worldwide (Goulding, Rogers, & Smith, 2003). In Westernized countries, the major cause of death has shifted from infectious diseases to non-communicable diseases (NCDs) that may be influenced by diet (Gorina, Hoyert, Lentzner, & Goulding, 2006; Heidemann et al., 2008). Since the older-adult segment of the population is increasing with such speed, there is a need to identify to what extent dietary choices correlate with quality of life and survival (Anderson et al., 2011). While aging earlier has been described as a process of progressive and irreversible biological changes resulting

in an increased risk of chronic diseases and cognitive and functional impairment (Khaw, 1997), there has been a shift in focus towards older adults' own resources and their own ability to impact and improve their quality of life (Dean, Grunert, Raats, Nielsen, & Lumbers, 2008). In order to meet this goal, it is necessary to focus on how to enhance the quality of life for older adults as well as the number of lived years (Dean et al., 2008). As people age, their food and energy intake tend to decrease, both for physiological and practical reasons (MacIntosh, Morley, & Chapman, 2000; Morley & Thomas, 1999). They do not feel as hungry as when they were younger and food preparation becomes a hassle. This may be a potential health risk because, although food intake is reduced with aging, the need for most nutrients is not reduced (Dean et al., 2008).

Norway is a Northern European country characterized as a social democratic welfare state, with generous universal public health insurance coverage, and predominately public health services (Esping-Andersen, 2013). The average life expectancy (2009) is 83 years for women and 79 for men (Krokstad et al., 2013). In Norway,

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we have seen substantial gender differences when people are asked if they are responsible for food provisions in their household. In 85% of households, the women are responsible for the food provisions. This is also revealed in women's food choices. Women scored higher on the presumably healthier dietary dimensions, whereas men scored higher on the presumably less healthy convenience diet dimension. Norway has the largest group of naive food consumers regarding food safety (Berg, 2004). In older people, dietary habits may be less related to how controlled they are and more related to their levels of openness, and emotional and social adjustment (Möttus et al., 2013). Being single or widowed was shown to be associated with a lower score in variety of food consumption, particularly vegetable variety, and this association was enhanced when combined with male gender, living alone, or having infrequent contact with friends, especially for men. Lower levels of contact with friends were associated with a reduced variety of fruits and vegetables in a graded trend for both genders; the trend was more pronounced among men. Among women but not in men, weekly contact with family was significantly and positively associated with vegetable variety (Conklin et al., 2014).

The enjoyment of food was closely linked to social networks and environment (Dean et al., 2008). Activities, experiences, and circumstances in relation to the procurement, preparation, and consumption of food and meals are significant parts of life (Grunert, Dean, Raats, Nielsen, & Lumbers, 2007). It is also known that social factors and eating environment are significant determinants for food intake (Meiselman, 1996, pp. 239–263). For older adults, the loss of social networks and changes in living circumstances are consequences of aging, and the probability of eating alone increases with age (Dean et al., 2008). Taken together, all these factors will influence older adults' relationships with food. Food fulfills basic functions for the body, but it also acts as a source of pleasure and for social construction, and in supporting the understanding of personal identity (Hausman, 2005). Considering the relationships between food and people's health, social interactions, and daily activities related to procurement, preparation, and intake, it is to be expected that food is among the important domains of life that affect a person's subjective well-being (Diener & Biswas-Diener, 2000; Diener, 2000; Hausman, 2005; Schnettler et al., 2013). The concept of life satisfaction is closely related to material, personal, and social resources (Diener, 2000; Diener, Emmons, Larsen, & Griffin, 1985).

In their study, Grunert et al. (2007) found a significant moderate correlation between "satisfaction with food-related life" and mental health. Good mental health facilitated high scores on life satisfaction and was related to food intake (Grunert et al., 2007). Furthermore, there have been reports of associations between psychological factors such as mood and stress and food consumption among elderly persons (Byers, Yaffe, Covinsky, Friedman, & Bruce, 2010). Studies have even shown that psychological stress affects elderly persons' eating habits (Wallis & Hetherington, 2004), health, and well-being and that greater perceived stress is associated with lower fruit, vegetable, and protein intake; increased consumption of salty snacks; higher intake of sweets; and lower participation in physical activity among older adults (Laugero, Falcon, & Tucker, 2011). We also know that stress may affect diet and physical activity (Laugero et al., 2011). In this study, an association between psychological stress and anxiety as barriers to healthy eating was documented (Laugero et al., 2011). Healthy diets are associated with better emotional well-being among older adults (Milte, Thorpe, Crawford, Ball, & McNaughton, 2015). It has been shown repeatedly that depressed older adults experience considerably more somatic symptoms, including loss of weight or appetite (Shapiro, Roberts, & Beck, 1999). A focus on food consumption and eating patterns is therefore, appropriate in order to

ensure that older people who are depressed receive the nutrition they require.

Earlier studies have focused on dietary components or specific nutrients in relation to both physical and mental health. To analyze food patterns that examine the overall diet may have some advantages, as food-pattern analysis can capture the complexity of the found diet (Anderson et al., 2011; Hu, 2002). Previous dietary studies have identified two major dietary patterns – the "prudent" pattern with high intakes of vegetables, fruit, fish, poultry and whole grains, and the "Western" pattern with high intakes of red meat, processed meats, refined grains, French fries and sweets/desserts (Heidemann et al., 2008; Hu, 2002).

Food patterns can be analyzed using one of two approaches – multivariate statistical techniques such as factor or cluster analysis, or dietary scoring methods informed by guidelines and recommendations or diet-quality indices (McNaughton, Ball, Crawford, & Mishra, 2008; Milte et al., 2015). Food patterns may play a major role in the health and functioning of people over the age of 65 (Drewnowski & Evans, 2001); furthermore, it seems likely that optimal nutrition and physical activity contribute significantly to the overall quality of life for older adults. No single group in our society can benefit more from improved diet than elderly adults (Evans, 1999). Among older people, relative food preference is found to be related to how open and emotionally and socially adjusted they are (Möttus et al., 2013). Although personality traits themselves are not likely to be modifiable in order to influence people's dietary behaviors, this information suggests potential barriers to a healthy diet (lack of intellectual curiosity—and perhaps information—and social embeddedness), which may be more easily modifiable. Indeed, of special interest is the finding that more open and intellectually curious people are the most likely to adopt healthy dietary habits; this may indicate that healthy food items are generally somewhat alien and unfamiliar to older people (Möttus et al., 2013).

Helping people to increase their life expectancy and improve their quality of life is the primary goal of the Healthy People report (Prevention & Promotion, 2011). In order to achieve both better health and longer life expectancy, increased attention to health promotion and food patterns among elderly persons is important. The lack of epidemiological information about people's health and lifestyles makes it difficult to identify suitable interventions for people at risk of developing unhealthy lifestyles. Enhanced health-related quality of life is a goal of health promotion, and there is, therefore, a need to increase knowledge about motivation for behavioral changes and perceived benefits as assessed using quality-of-life measures (Drewnowski & Evans, 2001).

Increased knowledge about motivation for behavioral changes, such as how to change elderly persons' food patterns from eating unhealthy food to eating healthier food, is needed. In this context, it is important to explore the impact of food consumption and life satisfaction related to mental health. The aim of this study is, therefore, to investigate associations between food patterns, life satisfaction, and mental health among Norwegian inhabitants age 65 + using the wave three cohort from the Nord-Trøndelag Health (HUNT) study. Nord-Trøndelag constitutes one of 19 counties and is geographically situated in the central part of the country. The population size is relatively stable (128 694 in 2006), and in- and out-migration has been low. In all the HUNT surveys, data were collected in each of the 24 municipalities in the county by using temporarily located health examination sites staffed by certified fieldwork teams (Krokstad et al., 2013). The education level in Nord-Trøndelag is mostly the same as the average for Norway in general, while income and pension are somewhat lower than for the average population in Norway (Norway, 2016).

Based on this background, the following hypotheses were

investigated:

- H1. Elderly persons in Norway who are depressed or have anxiety have an unhealthy diet.
- H2. There are gender differences among elderly persons in Norway related to food patterns and depression or anxiety.
- H3. Elderly persons in Norway who eat a healthy diet are more satisfied with life.

2. Method

The HUNT Study is one of the largest health studies ever conducted. It comprises a unique database of personal and family medical histories for investigating various issues related to health and lifestyle (Krokstad et al., 2013). A detailed description of the procedures related to data collection is published elsewhere (Krokstad et al., 2013), but a brief summary is given here. The first data collection in the HUNT Study was in 1980 and included 125 000 Norwegian participants; this was followed by a new data collection every eleventh year. The third wave of the HUNT study, HUNT3, invited 96 099 residents to participate. The analyses in this study are from that cohort.

2.1. Data collection

Letters were sent by post to 96 099 residents in Nord-Trøndelag inviting them to participate in wave three of the HUNT study; 2239 adults were unable to participate in this wave (having passed away or moved from the area). The total number of eligible participants in wave three was 93 860; of these, 50 807 (54.1%) decided to participate, and 11 619 were adults age 65 years or older.

The participants completed several questionnaires – questionnaires 1, 2, and 3 (Q1, Q2, Q3). Each participant answered the different questionnaires, and approximately 80% of the participants returned Q2 and Q3 (Krokstad et al., 2013). Q1 (demographic and background information) was completed at home before the participants attended the basic health examination, while Q2 and Q3 were completed at home following the health examination and returned by mail in a prepaid envelope. Q2 and Q3 were given to participants depending on their gender, age, comorbidities, selected diseases, diagnoses, or other sub-groups.

2.2. Q2 and Q3 measurements

In addition to background information (age, gender, marital status) and data on comorbidities (diseases), this study uses data from self-reported measures assessing life satisfaction, health-related behaviors (food patterns), friendship, anxiety, and depression.

Anxiety and depression were measured using the Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983). The HADS is frequently used to screen for psychological disturbance or distress (Costantini et al., 1999; Kugaya, Akechi, Okuyama, Okamura, & Uchitomi, 1998) and is considered a valid and reliable questionnaire (Herrmann, 1997; J. F.; Pallant & Tennant, 2007). Clinical experience in medical settings has indicated that the two conditions often coexist in the same patient (Costantini et al., 1999; Herrmann, 1997; Stavarakaki & Vargo, 1986). The original English version of the HADS has been translated into Norwegian and validated (Dahl, Stordal, Lydersen, & Midgard, 2009; Nortvedt, Riise, & Sanne, 2006).

Life satisfaction was measured using a one-item general measure of quality of life: “Thinking about your life at the moment, would you say that you by and large are satisfied with life, or are you mostly

dissatisfied?” (Bowling, 2005) as used by many national and international studies (Frisch, Cornell, Villanueva, & Retzlaff, 1992). This single question was not tested for validity in a Norwegian population, but the question is based on a thorough literature review on subjective well-being (Diener, Suh, Lucas, & Smith, 1999).

Friendship was measured using two questions from the four-item Social Cohesion and Support Index (SCS), which measures the individual experience of social support (Sørensen et al., 2002). The index has shown high predictive validity, interacting with negative life events and childhood adversities with regard to mental health.

The participants' health-related behaviors in regard to diet or food patterns were assessed by asking them a single question about how often they normally eat various foods like fruits and berries, vegetables, chocolate/candy, boiled potatoes, pasta/rice, sausages/hamburgers, and high-fat fish. The following response alternatives were presented: ‘0 to 3 times a month’, ‘to 3 times a week’, ‘4 to 6 times a week’, ‘once a day’, or ‘twice or more a day’. For intake of white, semi-grain, and whole-grain bread, the response alternatives were: ‘0 to 4 pr week’, ‘5 to 7 pr week’, ‘2 to 3 per day’, ‘4 to 5 per day’, or ‘6 or more per day’. Regarding the intake of liquids (milk, water, juice, and soda), the following response alternatives were provided: ‘seldom/never’, ‘1 to 6 glasses a week’, ‘1 glass a day’, ‘2 to 3 glasses a day’, or ‘4 glasses or more a day’. The question about food intake was not tested for validity before it was implemented in the HUNT3 Q1.

2.3. Statistical analyses

Data were analyzed using IBM SPSS Statistics (version 22). We performed both descriptive and analytic analyses to explore food patterns among elderly persons and to determine associations between food patterns and elderly persons' mental health and life satisfaction.

Descriptive statistics were used to describe food patterns among elderly persons and food-group consumption frequency variations were analyzed using Chi square statistics. A p-value of <0.05 was considered the cut-off point for statistical significance; the phi coefficient from the chi-squared statistics was also checked to evaluate the strength of the associations.

Food patterns were identified with the use of cluster analysis according to K-means cluster analysis, which is suitable for data with large sample sizes (Magidson & Vermunt, 2002); it creates groups of subjects with similar traits (Anderson et al., 2011; Hu, 2002; Leite et al., 2003; McNaughton et al., 2008). Cluster analysis allows individuals to be classified into separate groups. We coded categorical food variables into continuous variables by calculating the average weekly consumption. These continuous variables were standardized before running the K-means cluster analysis to make sure that the clusters were not influenced by food groups with specific frequency (Magidson & Vermunt, 2002). We used ANOVA tests to examine continuous variables and chi-square tests to examine relationships of categorical variables of various characteristics and potential gender differences ($p < 0.05$) with the dietary patterns. ANOVA analysis is reasonably robust regarding the size difference of groups, especially in large samples (Field, 2013; J.; Pallant, 2013).

2.4. Ethical issues

The information pamphlets for wave 3 of the HUNT study were developed in cooperation with the Data Inspectorate of Norway, the Health Directorate, and the Regional Committee for Medical and Health Research Ethics. The participants delivered Q1 and the written consent form when they attended the health examination

sites (Krokstad et al., 2013). The HUNT board and the Regional Committee for Medical and Health Research Ethics (REK, 608 187) have accepted this study.

3. Results

This study has used data from wave 3 of the HUNT study. Table 1 shows the demographic characteristics of the population and differences in friendship according to gender. More than half of the participants were married; a higher number of females were widowed, and almost 50% reported living alone. More women than men reported having friends who could help them if needed and friends with whom they could speak confidentially.

3.1. Food patterns from cluster analysis

The similarities in reported food patterns among the participants in the wave three of the HUNT study identified two clusters.

Cluster 1 consisted of participants with a more unhealthy food pattern that consumed a larger amount of foods and beverages such as; chocolate/candy, pasta, sausages, sugar free and sugary soft drinks, whole milk juice, white bread, semi-grain bread. Cluster 2 consisted of participants with healthy food patterns, such as a higher consumption of fruits, vegetables, boiled potatoes, oily fish, whole-grain bread and water.

More participants were grouped in cluster 2 ($n = 9128$) than in cluster 1 ($n = 2493$). Cluster 2 consisted of 4009 (43.9%) males and 5119 (56.1%) females, while cluster 1 included 1312 (52.6%) males and 1181 (56.1%) females. Fig. 1 illustrates the cluster centers of food patterns.

3.2. The Hospital Anxiety and Depression Scale (HADS) compared with food patterns

A one-way analysis of variance (ANOVA) showed that the participants from the “healthier” food-pattern group, **cluster 2**, had a

Table 1
Demographic characteristics and friendship according to gender.

	Total N (%)	Females N (%)	Males N (%)	p-value
Marital status				
Married	7121 (61.3)	3088 (49)	4033 (75.8)	<0.001
Unmarried	573 (4.9)	232 (3.7)	341 (6.4)	
Widow/widower	3286 (28.3)	2663 (42.3)	623 (11.7)	
Divorced	593 (5.1)	295 (4.7)	298 (5.6)	
Separated	46 (0.4)	21 (0.3)	25 (0.5)	
Total	11 619 (100)	6299 (100)	5320 (100)	
Living alone	3167 (48.1)	2371 (74.9)	796 (25.1)	*
Friends				
Have friends who can help if needed	9272 (92.3)	4968 (49.5)	4304 (42.9)	0.001
Have friends with whom to speak confidentially	9079 (90.3)	5044 (50.2)	4035 (40.1)	0.001

Total N = 11 619, Females N = 6299, Males N = 5320, Chi-square analyses. * No p-value (this is just a single question).

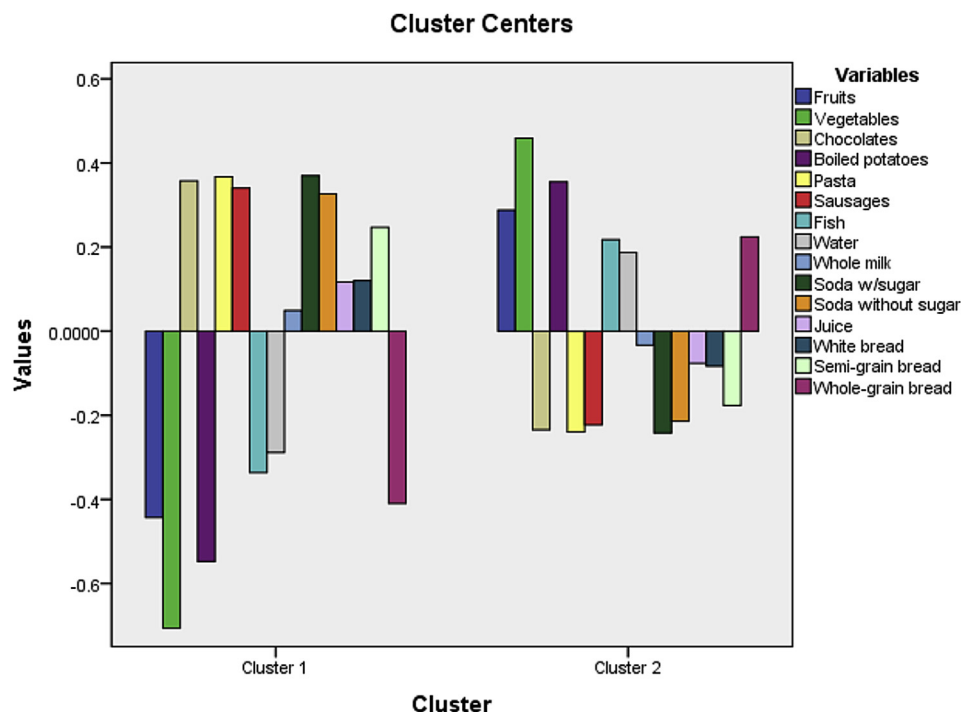


Fig. 1. Cluster centers describe the average value for each variable within each cluster and reflect the characteristics of the typical case for each cluster.

Table 2
HADS depression scores and food-pattern clusters.

Food patterns in clusters	Mean (SD)	95% Confidence Interval for mean		p-value
		Lower Bound	Upper Bound	
Cluster 1	4.65 (3.13)	4.51	4.77	0.001
Cluster 2	3.90 (2.85)	3.84	3.97	

(ANOVA analyses).

Table 3
HADS depression scores, food patterns within clusters, and by gender.

Food patterns in clusters		Mean (SD)	95% Confidence Interval for mean		p-value
			Lower Bound	Upper Bound	
Cluster 1	Female	4.48 (3.13)	4.30	4.66	0.012
	Male	4.81 (3.17)	4.63	4.98	
Cluster 2	Female	3.81 (2.86)	3.72	3.89	0.002
	Male	4.01 (2.84)	3.92	4.11	

(ANOVA analyses).

Table 4
HADS depression scores, food patterns between clusters, and by gender.

Food patterns in clusters		Mean (SD)	95% Confidence Interval for mean		p-value
			Lower Bound	Upper Bound	
Cluster 1	Female	4.48 (3.13)	4.30	4.66	0.001
Cluster 2	Female	3.81 (2.86)	3.72	3.89	
Cluster 1	Male	4.81 (3.17)	4.63	4.98	0.002
Cluster 2	Male	4.01 (2.84)	3.92	4.11	

(ANOVA analyses).

Table 5
HADS anxiety scores and food-pattern clusters.

Food patterns in clusters	Mean (SD)	95% Confidence Interval for mean		p-value
		Lower Bound	Upper Bound	
Cluster 1	4.09 (3.31)	3.98	4.29	0.001
Cluster 2	3.66 (3.05)	3.53	3.67	

(ANOVA analyses).

Table 6
HADS anxiety scores, food patterns within clusters, and by gender.

Food patterns in clusters		Mean (SD)	95% Confidence Interval for mean		p-value
			Lower Bound	Upper Bound	
Cluster 1	Female	4.72 (3.63)	4.50	4.94	0.001
	Male	3.57 (2.93)	3.37	3.77	
Cluster 2	Female	4.17 (3.26)	4.07	4.27	0.001
	Male	3.04 (2.62)	2.92	3.15	

(ANOVA analyses).

The findings show significant differences between genders in clusters 1 and 2.

Table 7
HADS anxiety scores, food patterns between clusters, and by gender.

Food patterns in clusters		Mean (SD)	95% Confidence Interval for mean		p-value
			Lower Bound	Upper Bound	
Cluster 1	Female	4.72 (3.63)	4.50	4.94	0.001
Cluster 2	Female	4.17 (3.26)	4.07	4.27	
Cluster 1	Male	3.57 (2.93)	3.37	3.77	0.001
Cluster 2	Male	3.04 (2.62)	2.92	3.15	

(ANOVA analyses).

The findings show significant differences between men from clusters 1 and 2 and between women from clusters 1 and 2.

lower mean anxiety and depression score compared to the other food pattern group, **cluster 1**, $p = <0.001$, in [Tables 2 and 5](#). There were also significant differences in depression scores between the genders in both clusters, in addition to differences in both depression and anxiety scores between the women in clusters 1 and 2 and the men in clusters 1 and 2, $p = <0.001$. Within the clusters, we found significant differences between genders ($p = 0.012$ & $p = 0.002$).

3.3. Life satisfaction compared with food patterns

The chi-square test showed that the participants from the “healthier” food-pattern group, cluster 2, had a higher mean life satisfaction score compared to cluster 1, $\chi^2(6) = 62.55$, $p = <0.001$, in [Table 8](#).

Table 8
Life satisfaction and food patterns.

Life satisfaction	Cluster 1	Cluster 2	Total	p- value
				0.001
Very satisfied	522 (21.5%)	2160 (24.1%)	2682 (23.5%)	
Satisfied	761 (31.4%)	3272 (36.4%)	4033 (35.4%)	
Somewhat satisfied	840 (34.6%)	2773 (30.9%)	3613 (31.7%)	
Neither satisfied nor dissatisfied	257 (10.6%)	687 (7.7%)	944 (8.3%)	
Somewhat dissatisfied	30 (1.2%)	62 (0.7%)	92 (0.8%)	
Dissatisfied	9 (0.4%)	19 (0.2%)	28 (0.2%)	
Very dissatisfied	6 (0.2%)	6 (0.1%)	12 (0.1%)	
TOTAL	2425 (100%)	8979 (100%)	11 404 (100%)	

(chi-square analyses).

4. Discussion

The aim of this study was to investigate possible associations among food patterns, life satisfaction, and mental health in Norwegian inhabitants age 65 + by employing cohorts from wave 3 of the HUNT study. This is a first investigation of relationships between life satisfaction and variables related to mental health and food patterns in a large sample of this population. Overall, our findings suggest that life satisfaction and mental health are associated with food consumption, and we have revealed clear gender differences. However, we cannot determine the extent to which these different relationships are linked; this study is a first step towards identifying how life satisfaction, mental health, and gender influence healthy food consumption among older adults in Norway. We investigated three hypotheses.

H1: Elderly persons in Norway who are depressed or have anxiety have an unhealthy diet.

According to the first hypothesis that elderly persons in Norway who are depressed or have anxiety have an unhealthy diet, the analyses showed that cluster 2 participants with healthier food patterns had lower scores on both anxiety and depression (Tables 3 and 6). Our findings are consistent with findings from other studies that have shown that perceived stress and anxiety are associated with unhealthy dietary patterns and food intake (Laugero et al., 2011). Findings from a different study (Byers et al., 2010) stated that a decrease in mood and anxiety disorders were common problems in the elderly adult group. They also found that mood and anxiety disorders were higher in older female adults than in males. Earlier studies have also shown that there is an association between anxiety and depression among older adults (Lenze, 2003), and when older adults experience depression and anxiety, it appears that their dietary and food patterns are affected. However, it might be turned around that if you have no one to share your meal with and have an unhealthy diet, you can become depressed. Our findings showed that healthier food patterns were associated with less anxiety and depression (Tables 3 and 6).

To feel anxious and to experience social loss and feelings of worthlessness are common symptoms of anxiety and/or depression among older adults (Shapiro et al., 1999). In our population, many of the elderly persons lived alone, and this may be an important factor in explaining our findings (Table 1). Depression can be caused by various circumstances, such as personal loss and lack of adaptation to a changed life situation (Shapiro et al., 1999). Findings in this study indicate that both depression and anxiety are potential health risk factors for older adults related to their nutrition. Effective interventions must, therefore, be more focused on increasing possibilities and resources related to literacy about healthy eating and promoting friendship and social networking among older adults.

H2: There are gender differences among elderly persons in Norway related to food patterns and depression or anxiety.

Concerning the second hypothesis about gender differences among elderly persons in Norway associated with food patterns and depression or anxiety, we found gender differences (Tables 3, 4, 6 and 7). We identified significant gender differences both between and within the two clusters “healthy” and “unhealthy”. Male respondents reported higher levels of depression but lower levels of anxiety in both clusters. Gender differences were also reported within cluster 2 (the healthier cluster). This means that respondents with both “healthy” and “unhealthy” food patterns reported differences regarding gender, food patterns, and depression and anxiety. Men showed higher depression scores and lower anxiety than women within both clusters. Differences in food patterns, therefore, may not be related to gender among Norwegian inhabitants older than 65 years of age.

It has been reported that women are responsible for the food provisions for 85% of households in Norway (Berg, 2004). Therefore, older males may not have the same experience and knowledge about nutrition and preparation of food as women, and that may influence the findings in our study. Food consumption in Norway, in general, is described as naive (Berg, 2004). Earlier research shows that the Norwegian population has a more traditional dietary style, influenced by traditional Norwegian food consumption (Health, 2015). This traditional Norwegian style of eating seems to be influenced more by “prudent” dietary patterns; however, Norwegians have also been influenced by “Western” dietary patterns in recent years. Our findings also confirm that older adults in Norway may be influenced by “Western” dietary patterns (Health, 2015). While whole-grain bread is still the most common bread in Norway, the consumption of white bread was twice as high in cluster 1 as in cluster 2 (Fig. 1).

H3: Elderly persons in Norway who eat a healthy diet are more satisfied with life.

According to our third hypothesis that elderly persons in Norway with a healthy diet are more satisfied with life, this study showed that participants with “healthier” food patterns, cluster 2, have higher mean scores on life satisfaction compared to participants with “unhealthy” food patterns, cluster 1 (Table 8). Respondents from cluster 2 were more satisfied overall with life than respondents in cluster 1. This result is consistent with findings from other studies where better-quality diets were associated with greater emotional well-being (Laugero et al., 2011; Milte et al., 2015). Even if the experience of reduced life satisfaction was not so common in our population, it is worth noticing that the association with food patterns was significant.

Our results showed that females reported having more friends than males did, and there were more females in the “healthy” food patterns, cluster 2, than males. Since food intake is also influenced by social factors and eating environment (Grunert et al., 2007; Meiselman, 1996, pp. 239–263), this is an interesting finding. It is more likely that older adults with friends share meals with their friends. This may have a crucial impact on their food patterns.

Having friends around and being part of a social network is also an important component of enjoying meals (Dean et al., 2008). Of the older adult respondents living alone, 75% were female (Table 1) with more females in the “healthy” food patterns, cluster 2, and more males in the “unhealthy” food patterns, cluster 1. This indicates that more males in our population show “unhealthy” food patterns than females do. Being married or cohabitating is shown to be statistically significantly associated with lower rates of mood, anxiety, and comorbid disorders compared with being divorced, separated, widowed, or never married (Byers et al., 2010). Hence, related to resources such as friendship, older female adults seem to have more resources than males have (Table 1). By contrast, older adult females may have other challenges stemming from living alone and having higher degrees of mood and anxiety disorders (Byers et al., 2010).

4.1. Limitations and strengths

This study has strengths and limitations. The strengths of this study are the inclusion of a uniquely large nationally representative population, the detailed registration of food intake, and the widely used scales, in this case, the HADS to collect valid reports of anxiety and depression. Having these data makes it possible to compare our results on associations between food patterns and mental health with other studies. One important limitation is that the results depend on subjective and local analytical decisions that might make it difficult to transfer the findings to other populations. Food patterns and diet may also be culturally influenced, and the validity and reliability of the food intake questionnaires may, therefore, be questionable. In addition, the life-satisfaction questions were developed for the purposes of the HUNT study and no validated scale was used. This may make it difficult to compare our findings with those of other studies focusing on life satisfaction. Moreover, there are fewer males than females in our population, which may have influenced the cluster analysis. Lastly, we have no indications regarding the socioeconomic status of the participants.

5. Conclusion

The results of this study indicate that older adults in Norway with healthy food patterns may have fewer mental health problems and higher life satisfaction than older adults with more “unhealthy” food patterns. The implications of these results may indicate that, in order to promote healthy aging and maximize quality of life, the society might profit largely from increasing the focus on how to promote older adults' social networks. Behavioral changes must focus on effective interventions to increase knowledge about healthy eating and how to enhance friendship and social networking among older adults.

Funding/acknowledgements

The EEA and Norway Grants.

The European Economic Area (EEA) Grants and Norway Grants represent the contribution of Iceland, Liechtenstein and Norway to reducing economic and social disparities and to strengthening bilateral relations with 16 EU countries in Central and Southern Europe and the Baltics.

Promoting Food Security in Portugal (ProFooSe Study) Portugal-Norway.

Conflicts of interest

No conflicts of interest.

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